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Systematic Biases in Estimating the Properties of Black Holes Due to Inaccurate Gravitational-Wave Models

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Gravitational-wave (GW) observations of binary black-hole (BBH) coalescences are expected to address outstanding questions in astrophysics, cosmology, and fundamental physics. Inference of BBH parameters relies on waveform models, and realizing the full discovery potential of upcoming facilities (such as the Einstein Telescope) hinges on the accuracy of these waveform models. Using linear-signal approximation methods and Bayesian analysis, we start to assess our readiness for what lies ahead using two state-of-the-art quasi-circular, spin-precessing models. We find that systematic biases increase with the spin of the BH. We ascertain that current waveforms can accurately recover the distribution of masses in the LVK astrophysical population, but not spins. For more extreme binary parameters, we find that systematic biases increase with detector-frame total mass, binary asymmetry, and spin-precession, with a majority of such binaries incurring parameter biases. Finally, we examine in detail three 'golden' events characterized by high mass ratios and spins.

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